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**INVESTIGATION OF COPPER VAPOUR AND  
ARGON ION LASER MARKINGS ON FILM  
SUBSTRATE.**

**By**

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# ABSTRACT

Two laser film marking systems have been designed and constructed. The marking systems are used to study the characteristics of a pulsed and a continuous-wave laser irradiation on motion picture film substrates. The continuous-wave laser used is a 15 W Argon-Ion laser by Spectra Physics. A 3 W sealed-tube copper vapour laser has been constructed as the source for pulsed laser. The laser employs an off-axis unstable resonator to obtain good beam quality and can be operated from 5 to 15 kHz with the maximum output power of 3 W.

The focused laser beams are used to remove the 8-micron thick photographic emulsion layer from 140-micron thick optically clear substrate base without or minimally damaging the underlying substrate. The emulsion removal rate and the resulting etching quality on two types of substrate bases (polyester and triacetate) are investigated.

Pulsed laser irradiated area often exhibits irregularly marked line width. The multipulse photothermal ablation process causes damage to the underlying clear substrate before emulsion removal is complete. The non-selective etching characteristic makes pulsed laser unsuitable for film marking purposes. Analysis of the continuous-wave laser irradiated area using digital imaging system indicates that vaporisation of the emulsion material occurs at a certain energy density threshold. The etching line width is laser power dependent due to thermal diffusion. Continuous-wave laser produces clean and consistent etching with laser-induced photothermal vaporisation mechanism. Triacetate substrate tends to have better marking quality than polyester substrate due to its higher thermal damage threshold. Therefore, higher fluence can be used to ensure cleaner emulsion removal.

# CONTENTS

ACKNOWLEDGEMENTS .....	ii
ABSTRACT .....	iii
CONTENTS .....	iv
CHAPTER 1 Introduction .....	iv
1.1 Laser Marking Systems.....	iv
1.2 Application in Film Subtitling Industry.....	iv
1.3 Conventional Hot-stamped Film Marking Process.....	iv
1.4 Objectives of This Study .....	iv
1.5 Outline of the Chapters.....	iv
CHAPTER 2 Review of Laser Film Markings.....	8
2.1 Laser Marking Process.....	8
2.2 Characteristics of Film Material .....	11
2.3 Laser sources.....	15
2.3.1 Copper Vapour Laser .....	17
2.3.2 Argon Ion Laser.....	18
2.4 Laser scanning technology.....	19
2.4.1 Scanners .....	19
2.4.2 Beam Shutters .....	22
2.4.3 Pre-objective and Post-objective Scanning .....	25

<b>CHAPTER 3 Design and Development of the Laser Marking System.....</b>	<b>27</b>
3.1 General Laser Marking System Configuration .....	28
3.1.1 Galvanometer Scanner .....	30
3.1.1.1 Construction and Operation .....	32
3.1.1.2 Position Detection .....	33
3.1.1.3 Servo Amplifier Card .....	33
3.1.2 Film Indexing and Winding Units.....	34
3.1.3 Microcomputer control and interface system.....	38
3.2 Copper Vapour Laser Marking System .....	40
3.2.1 Design and construction of the CVL.....	40
3.2.1.1 Laser Cavity Design .....	42
3.2.1.1.1 EEV XL7000 Sealed-off CVL Tube.....	42
3.2.1.1.2 CVL Resonator Design.....	45
3.2.1.2 High Voltage Switched-Mode Power Supply .....	48
3.2.1.3 Air-cooled Thyatron.....	51
3.2.1.4 Resonant Charging Circuit.....	53
3.2.1.5 Triggering System .....	55
3.2.1.6 Performance of the Copper Vapour Laser.....	57
3.2.2 Optical beam control .....	59
3.3 Argon Ion Laser Marking System.....	60
3.3.1 Argon Ion laser.....	62
3.3.2 Optics and Beam Control .....	63

3.4 Laser Marker Software Development.....	65
3.5 Measurement techniques .....	66
3.5.1 Digital Image Processing and Measurement Technique .....	66
3.5.2 Calibration of scanner speed .....	72
3.5.3 Determination of the film's light transmission characteristics.....	75
3.5.4 Laser Power Measurement. ....	78
3.5.5 Beam Profile Measurement.....	78
<b>CHAPTER 4 Results of Laser Markings on Film Substrate.....</b>	<b>81</b>
4.1 Film Marking Results. ....	82
4.1.1 CVL markings on Polyester film.....	84
4.1.2 Argon Ion laser markings on Polyester film.....	86
4.1.3 Argon Ion laser markings on Triacetate film. ....	92
4.2 Qualitative Analysis of Laser Marking Quality.....	98
4.2.1 Characteristic zones of laser-irradiated site .....	98
4.2.2 Characteristics of CVL Markings .....	101
4.2.3 Characteristics of Argon Ion Markings. ....	103
4.2.4 Comparison between Polyester and Triacetate Substrate Base .....	104
4.2.5 Observations using SEM.....	104
4.3 Quantitative Analysis of the Laser Markings .....	109
4.3.1 Effects of Laser Power and Irradiation Time on Marking Width .....	109
4.3.2 Dependence of Optimum Marking Speed on Laser Power.....	119
4.3.3 Dependence of Optimum Marking Width on Laser Power.....	121

4.3.4 Dependence of Clear Area Width on Laser Fluence..... 123

**CHAPTER 5 Discussions and Conclusion .....130**

5.1 Discussions .....130

5.2 CONCLUSION..... 135

5.3 Suggestions for Future Works .....137

**REFERENCE.....138**